of swallows, of which the "anatomy and general structure" are very well known. In that paper he will also see that I have attempted to compare the anatomy of all our swallows, with the structure of the American swifts, and with *Ampelis*, and a great many other birds. This paper of over one hundred pages, and numerous plates, is not found in Dr. Sharpe's works upon the life-history and structure of swallows find no place "Literature" of the *Hirundinidæ*. Numerous other important works upon the life-history and structure of swallows find no place in Dr. Sharpe's bibliography of this group. In this connection, then, it may be said that our author distinguishes but *twelve genera* of swallows in the world's avifauna, and of these I have carefully compared, illustrated and published full accounts of the anatomy of no less than *six* genera, or in other words fifty per cent. of those known at present to science. And, as *Stelgidopteryx* was included among these, I very much question that any very marked anatomical differences will be found to exist among the unexamined types.

Further, as has been the case with not a few other anatomists, I have treated the subject of the systematic position of the swallows in numerous places, but more particularly in my "Contributions to the Comparative Osteology of the Families of North American Passeres," in which the skeletons of all the passerine birds in the United States were, in a comparative way, passed in review, the swallows with the rest. This is another formal work dealing with the *Hirundinidæ*, overlooked by our bibliographer of this family of birds. R. W. Shufeldt.

2508 University Place, Washington, U.S.A., June 11.

### Rotifers in Lake Bassenthwaite.

It may be of some interest to readers of Nature to call attention to the fact that during the warm days of June 16–18, the beautiful Rotifer *Asplanchna priodonta* was to be found in the surface waters of Lake Bassenthwaite, Cumberland, in very great abundance. After dragging a small tow-net through the water from a row-boat for twenty minutes, the water collected in the bottle attached to the end of the net was perfectly turbid with the multitude of these animals, interfering very materially with the observation of the other constituents of the plankton. Observations taken by Mr. Ashworth in different parts of the lake in the early morning, mid-day and the evening, proved that they were not present merely in a localised cloud, but distributed in immense numbers all over the lake, from the surface to a depth of ten feet or more.

The observation is of interest, as the "Lakes" are not given in the great work on Rotifers, by Hudson and Gosse, as a locality for this genus, nor is there mention made of its occurrence in such great numbers. Perhaps some of your readers may be able to inform me if this phenomenon has previously been recorded in England. Sydney J. Hickson.

The Owens College, Manchester.

### Lion-Tiger Hybrid.

Some of the readers of Nature who have the opportunity of visiting the exhibition at Earl's Court may be interested to know that one of the members of the "Happy Family" now on show there is evidently a hybrid between a lion and a tiger. The animal appears to be about two years old. By artificial light the ground colour closely resembles that of a lion, being tawny rather than reddish yellow; but the tiger-stripes, though faint, are quite visible, especially on the tail. Such stripes might perhaps be mistaken for unusually strong cub-markings of the lion retained for an unusual length of time. But apart from the stripes, the tiger-strain comes out strongly in the blackness of the corners of the mouth, the hairs of the lips in this place being jet black in the tiger, white in the lion. R. I. Pocock.

Natural History Museum, June 22.

### Transference of Heat in Cooled Metal.

J'ai l'honneur de vous envoyer pour votre si intérressant journal, une remarque qui pourra intéresser peut-être quelques lecteurs de Nature.

Il s'agit d'un phénomène certainement bien connu et qui n'a peut-être pas attiré l'attention des physiciens, comme il semble le mériter. Prenons dans la main l'extremité d'une barre de métal et chauffons l'autre extrémité aussi fortement que possible, mais pourtant de manière à pouvoir tenir la barre sans se brûler par la première extrémité. Cela étant, refroidissons brusquement l'extremité chauffée, soit en la plongeant dans l'eau, soit au moyen d'un jet d'eau. *Nous constatons alors que la température de la partie non chauffée monte et que nous sommes obligés de lâcher la barre, si nous ne voulons pas nous brûler.* C'est ce que savent très bien, tous ceux qui ont travaillé à la forge ou qui ont fait des soudures de petites pièces métalliques tenues à la main. Les ouvriers disent que la chaleur est *repoussée* par le froid vers la partie non chauffée. Le phénomène a-t-il été étudié scientifiquement et connait-on sa cause? Henry Bourget.

Astronome adjoint à l'observatoire de Toulouse, juin 14.

### Parker and Haswell's "Text-book of Zoology."

In reply to Prof. Ray Lankester's references to me in his review of Parker and Haswell's "Text-book of Zoology" in this journal for May 12th, I should like to state as follows:—(1) That I had nothing to do with correcting the "final revise" of this book. (2) That the new English edition of Prof. Wiedersheim's "Comparative Anatomy of Vertebrates" is not a translation, but an "adaptation." (3) That the assertion with regard to the ossification of parts of the skeleton in Elasmobranchs in the latter work is not the same as that to which Prof. Lankester objects in the "Zoology," whether the latter be right or wrong. (4) That Götte in 1878 distinctly stated that true bone is undeniably present in the vertebral centra of several Elasmobranchs the histology of which he describes, and that all kinds of intermediate stages between calcified cartilage and true bone occur in these centra. (5) That in the fourth edition of Marshall and Hurst's "Practical Zoology" true bone is said to occur in the centra of *Scyllium*, and that this statement does not appear in previous editions of the book. (6) That in the fourth German edition of Wiedersheim's "Grundriss der vergleichenden Anatomie," which was published a week or two ago, the centra of Elasmobranchs are described as being "kalkknorpelige resp. knöcherne." W. N. Parker.

---

## *SOME RESULTS OF MY RESEARCHES ON OCEANOGRAPHY.*

By Albert, Prince of Monaco.

The devotion that has been quite lately given to the new science called "oceanography," has decided me to dedicate some of the strongest efforts of my life to its advancement. I set about my work in 1885 with a small sailing schooner of 200 tons, the *Hirondelle*, and I explored the Atlantic as far as the coast of Newfoundland, and as deep as 1600 fathoms, without any power greater than the arms of my fourteen sailors. Later on I built a steam vessel of 560 tons, better fitted for such rough work; this was the first *Princess Alice*. Now I

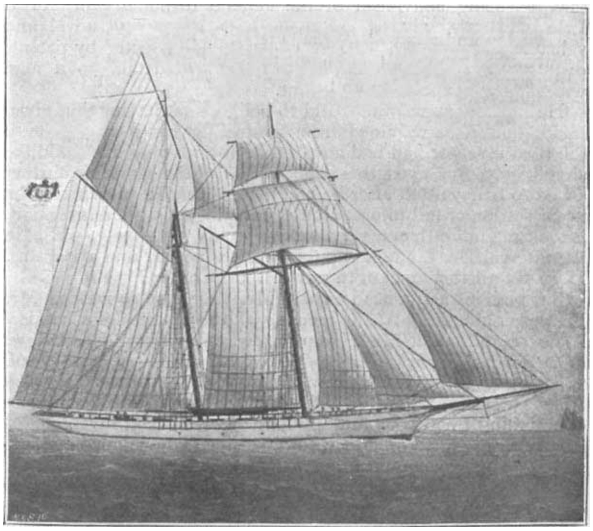

Fig. 1.—The *Hirondelle*.

have just built another one still more powerful, of 1400 tons, also called *Princess Alice*. Thus the love of science, and the successful combat of the difficulties met with in its employment in researches at sea, enlarges constantly the horizon and demands more powerful means.

I began by trying to find out experimentally how the currents moved on the surface of the Atlantic, and for this purpose I dropped, in three different cruises, 1675 floats between Europe and North America. These floats were mostly a strong glass bottle protected by a sheet of brass, ballasted so as to keep just at the level of the surface, and containing a document written in several languages to invite the finders to return it with particulars as to place and date.

Out of these, 226 had been returned to me up to the year 1892, when I drew, by working scientifically the course that each of them had probably been following, a definite map of the currents. And I may add that this result is certainly very near the truth in its general lines, because the elements employed have always been numerous for each region.

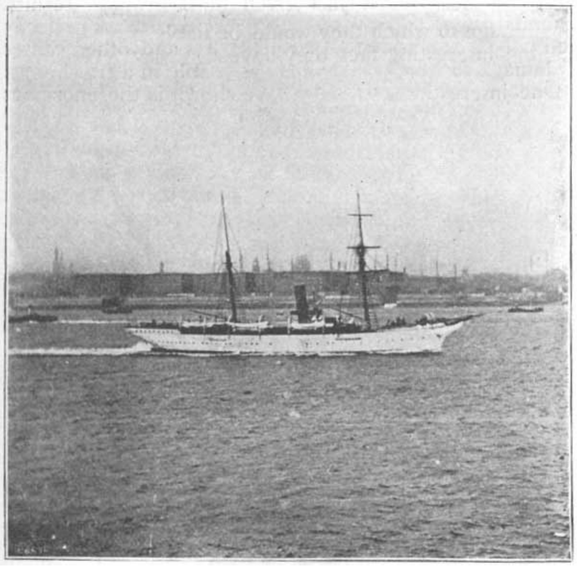

FIG. 2.—The second *Princess Alice*.

The floats have landed on almost all the shores of the North Atlantic, from the North Cape to the south of Morocco, along Central America, and on the islands of Canaries, Madeira, Azores, Antilles, Bermudas, Shetlands, Hebrides, Orkneys and Iceland. Not one has appeared as far south as the Cape Verd islands.

They show an immense vortex which begins towards the Antilles and Central America with the Gulf Stream, which issues from the Gulf of Mexico, and with the equatorial current; passing the banks of Newfoundland at a tangent, it turns to the east, approaches the European coasts, and runs southward from the Channel to Gibraltar, after having sent a branch which runs along the coast of Ireland and the coast of Norway as far as the North Cape.

It then returns to the west, encircling the Canaries. Its centre oscillates somewhere to the south-west of the Azores.

My observations enabled me also to establish a very good average for the speed at which these floats have been travelling in the different sections of the vortex, and for every twenty-four hours.

Between the Azores, France, Portugal and the Canaries: 5·18 miles.

From the Canaries to the Antilles, the Bahamas, and as far as the Bermudas: 10·11 miles.

From the Bermudas to the Azores: 6·42 miles.

The mean speed for the North Atlantic is 4·48 miles. These values being under rather than over the truth.

When I began to work on the bottom of the sea to study animal life, as constant sounding is required for that purpose, I found that most of the sounding machines in use were defective, and I had one constructed according to my own ideas. It is completely automatic in all the details of its action, so as to allow a single man to take a sounding at any depth; the line that I have used for four years is no longer a steel wire, but a steel cable made up of many very thin wires; it is, therefore, stronger and more pliable. It is paid out at the required speed, hauled up again, dried, greased, and regularly rolled up on a drum by an automatic guide. The brake is a powerful spring.

Among the observations for which this machine is wanted, I will mention those concerning the temperature of the water at different levels. I am using, to obtain them, a thermometer designed for my cruises by Mr. Chabaud, a French instrument maker. It is very much like Negretti and Zambra's pattern, but the part of the tube containing the mercury reservoir is recurved so as to prevent the mass of this metal forcing itself by its own weight through the constricted angle which serves to break the column; and such an accident used to happen now and then.

When I went into the study of the density of the water, I found that Buchanan's bottle was the best for collecting samples of the stratum nearest to the bottom. But to obtain samples at any intermediate depth, Dr. Jules Richard, chief of my laboratory, has designed a thoroughly trustworthy instrument with which we have been able to study the gases contained in these samples, and to demonstrate that they are not dissolved in the depths at any other pressure than they are at the surface. This instrument can be shortly described by saying that it is a bottle filled with mercury, and inverted with its neck dipping into a dish also full of mercury. In this position it is sent along a steel cable as far as the required depth, where it meets a platform, and where a mechanical action raises the neck of the bottle over the mercury of the dish. The mercury of the bottle then runs out into the dish, and water takes its place. Soon after this, a messenger sent from the ship reaches the instrument, and acts so as to dip again the neck of the bottle into the dish containing the whole of the mercury. In this last position the instrument can be hauled up without any risk of the sample of water being mixed with outside water; and if there was any gas dissolved in it at a high pressure (which was not the case in my observations), it would gather on the surface of the sample, as this pressure would diminish as the instrument came nearer to the surface of the sea. This research led Dr. Richard to announce in 1895 the presence of argon in the swimming bladder of certain fishes.

Very soon after this, I had the satisfaction of presenting the French Academy of Science with very interesting observations made by M. Knudsen during the cruises of the Danish steamer *Ingolf*. This investigator proved by analyses of samples of water made *in situ* that predominance of animal or vegetable life in any part of the sea causes the variations in the amount of contained oxygen or carbonic acid.

One of the most difficult questions to investigate is the penetration of light in the depth. Photographic plates turned towards the heavens have been exposed by Hermann Fol, and impressed as deep as about 200 fathoms. I have myself used, as far as about 90 feet, an instrument invented by Dr. Regnard for my experiments; it is a cylindrical box with a narrow slit in the direction of its length. Inside is a sensitive paper, which is made to pass slowly under the slit by means of clockwork, capable of running for twenty-four hours. If there is any light falling on it, it is shown on the paper when developed, and with the increasing or the decreasing power before or after noon. But by this method one obtains no absolute information, as some more sensitive matter may be discovered any day.

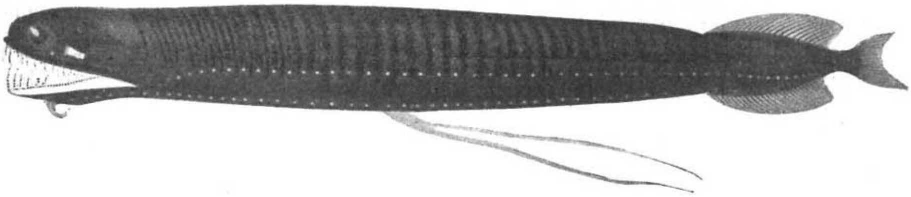

FIG. 3.—*Photostomias Guernei.*

Indeed, light exists everywhere in the depths: where the rays of the sun do not reach themselves, numbers of animals furnish it by special phosphorescent organs which are real accumulators of light. Besides, I have found animals with perfect eyes at every depth; and science teaches us that an organ always atrophies or disappears when the conditions are such as to prevent its use.

Among the special circumstances created by the statical and dynamical conditions of this space, organic life presents itself under aspects which appear strange to those who are accustomed to its appearance near the surface. I endeavoured to obtain from all the levels of the sea as many samples of the species belonging to them as it was possible, but I had to find other apparatus than the old trawl used for the former scientific cruises, which can only get animals fixed on the bottom of the sea, or hiding in the mud, or possessing very slow means of progressing. Of course I have used it a great deal, because no other instrument can collect for us a certain fauna; but when it occurred to me that there must be in the deep waters some nimble animals able to escape such a net as a trawl, I first built a trap of a special shape and very large, in order to attract these supposed animals, when properly baited. The trap is lowered to the bottom with a steel cable, and hauled up again after having been left there for a day or two attached to a buoy.

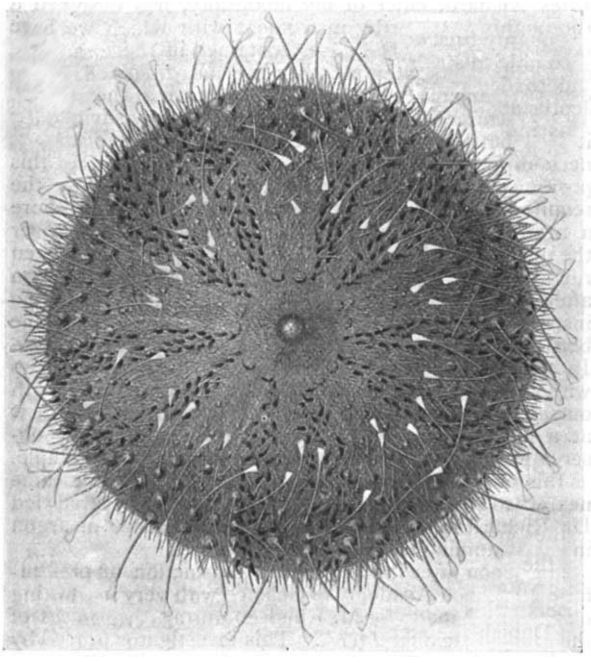

FIG. 4.—*Sperosoma Grimaldii.*

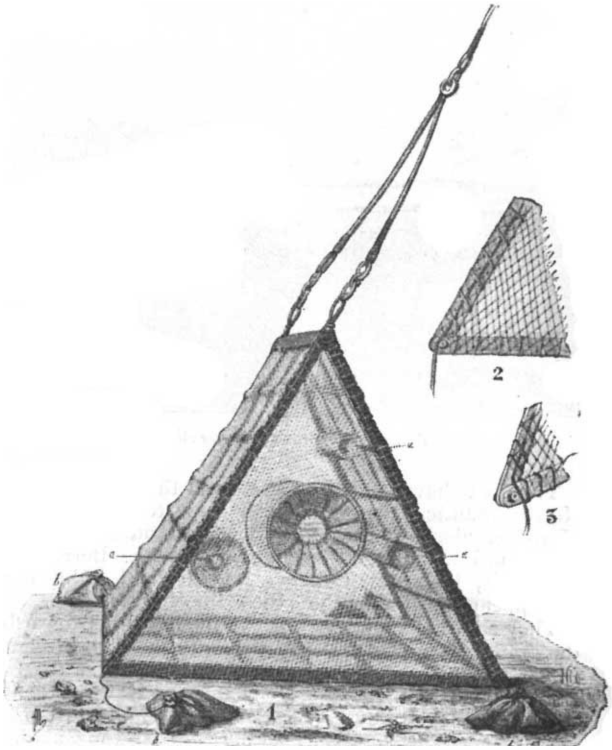

FIG. 5.—Deep-sea trap.

The handling of this was very difficult in the beginning, and required several years' practice to be brought up to positive rules, but it has given most brilliant results, animals quite unknown coming into my hands perfectly well preserved against shocks, frictions and other causes of damage to which they would be liable in a trawl.

One interesting fact they have shown is the enormous numbers in which some animals exist in certain places. As an example, I obtained one day in a trap that had been lying on the bottom at 700 fathoms depth for twenty-four hours, 1198 fish called *Simenchelys parasiticus*, which was only known by one or two samples in a more or less imperfect state. I have succeeded in sending these traps as low as three thousand fathoms with complete success.

On another occasion my trap brought up a new crab, one of the largest ever known, *Geryon affinis*, and there were sixty-four specimens of it. Curiously enough, several of them, which had not yet found the entrance of the trap when it was hauled up, made the whole voyage of many hundreds of fathoms, clinging voluntarily to the outside of the trap.

Another time, again (and this was of a special interest because the event took place in the great depths of the Mediterranean, where previous investigations with trawls had led to the supposition that life was almost absent), a trap returned with over eighty sharks called *Centrophorus squamosus*.

For two years I have been trying to use in great depths a net which is very good when used on inshore fishing grounds. This is the trammel; but its use has proved to be exceedingly difficult because of its frailty and its size. Still, I have already obtained with it results which prove how useful it can be. I worked it as low as 1500 fathoms.

The most difficult regions to explore in the sea are the intermediate depths between the surface and the bottom, because the animals living there are very active and very suspicious, and have ample space where they can escape easily, and where they find abundant prey for their food. Besides, the apparatus used must be built in such a manner that they show at what level animals have been caught, or else the scientific conclusion can not be made complete; therefore such an apparatus must be so as to be lowered shut to the determined region, there open and work, and lastly shut again before leaving the region.

Many instruments have been devised for this purpose, but I know only one of them offering complete safety; this is a net invented by Prof. Giesbrecht, which has been slightly altered by Dr. Richard and myself. But it would be difficult to make it of a large size; therefore we get only specimens of very small species.

Lately I have obtained a certain number of large animals living in those intermediate depths and belonging to the very interesting group of cephalopods, by examining the stomach of several cetaceans who feed upon them. Since this interesting fact, I added to the scientific gear of my vessel a complete whaling arrangement. This new method has given me the most remarkable animals of my whole collection; one especially, the *Lepidoteuthis Grimaldii*, can be classified in no actually known species, genus, or even family of his order. It was vomited in 1895, during the dying struggles of a sperm whale, but had unfortunately lost its head by the last adventures of its life. The fragment is about one yard in length, and the complete animal must have measured over seven feet; adding the arms, we get a monster of colossal strength. Its most remarkable feature is a cuirass of large prominent scales which cover its visceral bag; these are quite unknown with animals of that order.

The vomitings of the same sperm whale, who covered two acres of the sea with his blood, contained another immense cephalopod, a Cucioteuthis with arms as strong as a man's, and carrying suckers armed with claws as powerful as those of a tiger; this animal is furnished with luminous organs.

In 1897 another large cetacean, that I was attacking with my whale boats, vomited a large fragment of a cephalopod which was peculiar in being of viscid substance not unlike glycerine; no net could retain it, and we only secured it by "dipping" it up with a large tub as well as the mass of water in which it was floating.

But it will be convenient to remind the reader that cetaceans divide themselves into two principal groups. One, to which belongs the right whale or other marine mammals chased by whalers, and who feed upon very small animals that they absorb simply by moving about with their mouths open. They have no teeth, but a sort of sieve made of what is called whale bone.

Another group, to which belongs the sperm whale, is armed with powerful teeth, a single one weighing sometimes as much as six pounds. They live upon big preys, mostly cephalopods, as aforesaid. These cetaceans are ferocious, while the others have a much milder temper, and some of them, as the *Orca Gladiator*, can be very dangerous to attack. Two years ago I chased a school of three of these, just off the Monaco rock, and very soon one was struck by my whaler's harpoon. While it was ending with violent struggles, the two others came alongside the whale boat and seemed willing to fight for their companion. They swam round and round, sometimes so close that the men touched their enormous backs with their hands. I had to release at once that boat, and for an hour we were (seventeen men and three boats) engaged in a most grand wrestling. The result was that a second orque was killed by a spear stroke.

On the previous day we had caught a grampus, also a cetacean; so we returned to the harbour of Monaco with three of these monsters captured within fifteen miles of that place.

The orques are black and white, much like a magpie, and these were 16 and 18 feet long. They seem to feed exclusively on porpoises. My two, when opened, contained each of them a dozen pieces of porpoise in its stomach like heaps of paving-stones: they had just taken a meal when they were struck.

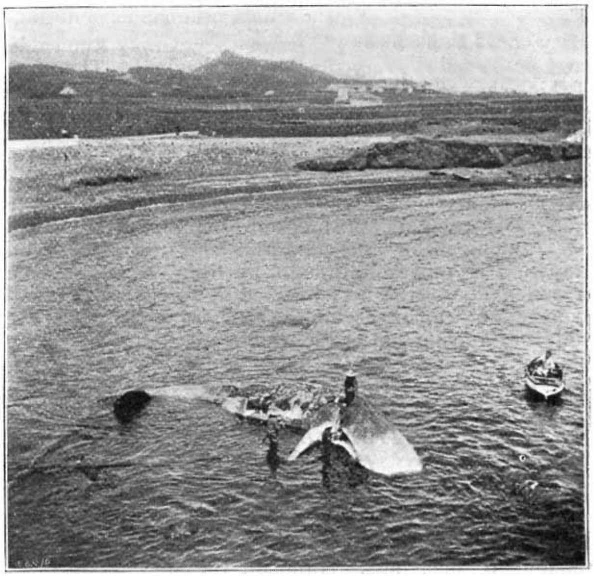

FIG. 6.—Sperm whale being broken up.

Among many remarkable facts that I have observed during my studies of the ocean, one has especially called my attention because of its practical consequences; that is, the intensity of life appearing on the surface at certain hours.

Almost in every region of the North Atlantic where I have carried on my investigations, I have ascertained the existence of large tunny fishes which morning and evening chase smaller fishes whose shoals cover sometimes the sea on such a large area that we sail or steam hours and hours across them.

Then, if we sight some wreckage—as a log or a barrel—we always find under it or near it fishes of a good size and of different species that never seem to abandon this guide that they have chosen, and that takes them across the Atlantic. They are very easily caught with a fish spear, and the tunny fish are hooked with a tow-line baited with a rough imitation of a squid.

I once speared in that way fifty fishes weighing 300 pounds altogether, which were following a log on the Atlantic; and their number seemed not to have been much lessened by such a breach. Another day, while I was alongside a log, very anxious to make a good bag, because I had just picked up the crew of an English vessel, the *Blue and White*, sunk under my eyes, and we were already short of provisions, I was disturbed in this occupation by a large shark, who was himself living about the log, and who, after having looked at me with his cruel eyes, stuck himself under my dinghy. His head and his tail projected beyond the ends of this boat, and the friction of his back against the keel gave a rather uncomfortable feeling. Therefore, after I had made a few catches of the usual fishes, which gave him some excitement, I left the log and returned on board, escorted for some distance by the disagreeable wanderer.

On the other hand, we have on many occasions caught dozens of tunny fishes in a day by simply using the aforesaid tow-line.

Thus I can state that many sailors wrecked on the Atlantic, and abandoned for days and weeks on its apparently uninhabited wilderness, have died of hunger among a most abundant and attainable food, and that they could have been saved had they simply known it, and possessed the very simple gear required. Therefore I think that all the principal boats of a ship ought to be permanently provided with a few lines and hooks and with a fish spear.

There is no very obvious explanation of the fascination which any floating or drifting object seems to have for marine animals of various sorts. Even turtles, which are very stupid, and sperm whales or other cetaceans, which seem intelligent, are attracted by a buoy or by a ship, and any kind of apparatus brought up from the depth, even a cable end, is often accompanied by single fish or small companies, which get hopelessly bewildered when the object disappears out of the water.

## *REPRODUCTION BY PHOTOGRAPHIC PROCESSES.*

IT is not difficult to understand the survival and general adoption of those photographic methods in which the light, by shining upon the sensitive surface, produces shading or blackness. Although the first product, as obtained in the camera, by such a process is itself useless as a photograph, the lights and shades being reversed; this "negative," as it is termed, becomes a means of reproduction, as by laying the negative over a sensitive surface more or less similar to that first used, and allowing the light to shine through it, any required number of prints or copies in true light and shade may be obtained. Such a process is necessarily slow, as in working upon this system the production of each individual print or photograph involves an exposure to light, and the rapidity of reproduction is limited by the chemical intensity of that light which is available, and also by the sensitiveness of the material used.

Another system of reproduction, and one which is month by month becoming of greater industrial importance, evades the necessity of a special exposure to light for obtaining each individual print or copy, this being effected by the production of a printing surface or plate from which copies may be printed by mechanical means. Prints obtained by a special exposure to light for each copy are often called solar prints, or true photographs, while those prints which are printed mechanically from a plate or surface which itself is photographically produced, are now so generally called process prints, that the title of "The Process Year-Book"[1] is by no means ambiguous in its meaning to those who are current with the technological phraseology of the day. "The Process Year-Book" well represents the present state of process craft, not only by giving numerous representative illustrations, but by articles from the leading authorities in such matters. The articles are, however—as should be in a work of this kind—written rather for the expert than for the comparative outsider, and we shall give our readers a better general idea of the development and present condition of reproduction by the photo-mechanical processes if we drift away from our text, than if we confine our remarks to the matter before us in Mr. Gamble's volume.

It is interesting to note that the early experiments of Nicéphore Niepce, which were commenced as far back as 1813, were undertaken with the view of obtaining printing surfaces by photographic agency, so the history of photographic process work includes the first chapter in photographic history. Niepce coated lithographic stones or metal plates with a varnish the solid material of which tends to become insoluble in its menstruum where exposed to light. There are many such varnishes, and as an example we may mention a solution of bitumen in a volatile oil like that of turpentine. Those portions of the film which are still soluble after exposure are next dissolved away, while the insoluble portions form a ground, or resist against the etching fluid, which is next used. A heliographic etching on metal by Niepce, made about 1824, is still extant, and in 1827 he brought several specimens to England; but very little attention was given to photographic matters until, in 1839, the daguerreotype was introduced with its perfect rendering of the most delicate degrees of light and shade, and this by a very short exposure in the camera.

Considering that the daguerreotype image is of the nature of a deposit on a smooth metal surface, the idea of moulding by the electrotype process so as to produce an intaglio printing plate, naturally presented itself; as also that of etching the metal, in the hope that the image on the surface might serve as a local resist. Grove, Chevalier, Claudet and others made experiments with the view of obtaining printing plates from the daguerreotype by such methods, but most etchings were wholly unsatisfactory; and although the electrotype casts of the plate were perfect as reproducing in intaglio every tone of the original, the plate had neither that grain nor that depth which are essential to the satisfactory printing of a photo-engraved plate.

Mr. Fox Talbot, whose Calotype or Talbotype process on paper was made public practically at the same time as the daguerreotype, was one of the first to produce satisfactory intaglio printing plates, and his method is specially interesting as being the basis of that process of intaglio photogravure which is most in use at the present time. Talbot coated the metal plate with a wash or film of gelatine made sensitive to light by the addition of bichromate of potassium, and he exposed under a transparent positive. Where the light acted to the full, the gelatine became impervious to aqueous fluids; but where protected from the light, the film allowed such fluids to pass readily, and between these extremes were all degrees of intermediate resistance to the passage of the aqueous etching fluid. Talbot used such saline etching materials as platinic chloride or ferric chloride, and from time to time he suggested and used various methods of producing an ink-holding grain, such as a resinous dust, a network, or a kind of aqua-tint ground formed by the evaporation of a solution of camphor and common resin in chloroform. The chief present-day method of photogravure is Herr Klic's modification of the Talbot method, the chief differ-

---

[1] "The Process Year-Book, a Review of the Graphic Arts." Conducted by William Gamble. (London and Paris: Penrose and Co.)